Ogan, Alfred
Railway collisions prevented.

RAILWAY COLLISIONS PREVENTED.

BY

ALFRED OGAN.

"In the examples which I here bring in, of what I have heard, read, done, or said, I have forbid myself to dare to alter even the most light and indifferent circumstances. My conscience does not falsify one tittle. What my ignorance may do, I cannot say."—MONTAIGNE.

LONDON:
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1855.

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CONTENTS.

TO

CAPTAIN R. H. BARLOW,

GENERAL MANAGER OF THE SOUTH-EASTERN RAILWAY.

DEAR SIR,

You have at all times, during your official connexion with the South-Eastern Railway, evinced a most laudable anxiety to protect the lives and persons of its passengers, and the property of the Company under your management, from the terrible effects of a "Collision" of trains. The application of the ordinary Electric Telegraph to record the transit of a train is due to your penetration and practical knowledge of the requirements necessary to prevent such lamentable accidents; you were likewise the first to test, by severe experiments, and afterwards to recognize the practicability and usefulness of the system and invention which I have now feebly attempted to describe. It is only just, therefore, that your name should be associated with the introduction of a means which will in future render Railway travelling the safest, as well as the most expeditious and comfortable that can be employed.

With this object, and in the hope that your continued exertions for the safety of the public may be fully recognized and appreciated by them, I respectfully dedicate the few following pages to your perusal.

I have the honour to subscribe myself,

Dear Sir,

Yours most respectfully,

THE AUTHOR.

2, TURNWHEEL LANE, CANNON STREET,
LONDON, *February*, 1855.

PREFACE.

WHILE deeply lamenting the unfortunate Railway Collisions by which the public has so frequently and severely suffered, the Author was led to a full consideration of the subject, from a conviction that it was only requisite to look the matter boldly in the face, in order not only to discover their cause, but to prevent their recurrence.

In tracing the origin of accidents arising from collisions of trains, he found that many valuable suggestions for their prevention had been from time to time made by the Government Inspectors of Railways, but which, from being diffused through a mass of Parliamentary Reports, lost half their force; he has therefore endeavoured to collect and concentrate these official opinions in support of his own views, which he felt might otherwise be passed lightly by; but which he now hopes, confirmed as they *mainly* are by those of eminently practical men, will be favourably regarded.

It can scarcely be supposed that Railway Companies, whose interests are so deeply affected by these sad occurrences, are not desirous of terminating the dangers to which the lives of the public, and their own property have been so long exposed, if effective remedial measures can be suggested; were there no other motives to actuate them, "economy" would surely

be an inducement sufficiently powerful, to cause them to adopt any plan which, after a fair trial, had been found to accomplish such a very desirable result as the putting an end, for ever, to these disasters. This, through the skill and intelligence of Mr. Tyer, an Electrical Engineer, may now be considered as "*un fait accompli.*" There is no longer any room for scepticism,—the system has been tried sufficiently long, and under every variation of weather, temperature, speed and succession of trains, and has been so uniformly successful, that it must effectually solve all doubts and silence every objection

The Author deems himself privileged in being permitted to associate the name and plans of a gentleman of so much ability in his profession, in connection with, and in support of his own ideas, as well as in being able to exhibit to the public and to Railway Companies by what simple means "collisions," with all their frightful consequences, may be numbered amongst the things that were.

2, Turnwheel Lane, Cannon Street,
London, 1*st February*, 1855.

OPINIONS OF THE PRESS.

Morning Chronicle, December 23rd, 1853.

An attempt has recently been made to devise a set of railway signals, by means of electricity, which shall have the effect of diminishing, if not entirely preventing, all future collisions on railways. The plan, which is the invention of a Mr. Tyer, is based on the principle of electro-magnetism, and does not differ much in its operation from the electric telegraph. It is proposed to place—say at the distance of a mile from each station—a piece of metal supported on a frame of wood, the frame constructed on the principle of an inclined plane. These pieces of metal, placed on both sides of the line, and exactly opposite each other, act as the two poles of magnetism, to be connected together by springs placed at the bottom part of the engine frame, and connected with an electro-magnet on the engine itself. Supposing these metal plates to be connected by a wire with a machine at the station, the station-master can set the machine at his pleasure either at the point of "all right" or "stop." If the latter signal be made, the engine, by passing over the two metal plates, connects the two poles together, and moves the magnet on the engine, which in its turn will ring a bell by the side of the engineer, and may be made to blow the steam whistle, or even to shut off the steam altogether; in any case allowing the engineer plenty of time to pull up before he arrives at the place of obstruction. There is another invention by the same ingenious mechanist, which enables the engine-driver of a train to communicate with the station before he comes to it, and again some distance after he has left it. This is effected by wires, connected with what is called a "spring treddle," placed so close to the rails that the flange of every wheel in a train must press against it. The pressure gives birth to an electrical current that acts upon a bell at the station, causing it to continue ringing as long as the train may be passing over it. The same process is accomplished on the departure from the station—say a mile beyond it, or at whatever distance they may be placed—so that the station-master will always be apprised of the number of trains in the neighbourhood of his station, and need never allow the one to come on till the other has got fairly clear. The latter part of the invention, we understand, has been in use for the last seven months on the South-Eastern Railway, and where, in its practical working, it has given great satisfaction.

Daily News, December 23rd, 1853.

An invention, the object of which is the achievement of this very desirable result, was submitted yesterday to a private view by Messrs. Ogan and Goddard, at their office, No. 2, Turnwheel-lane, Cannon-street. Availing themselves of the electro-magnet, which is now applied to such a variety of purposes, the inventors undertake to establish, by means of wires, a communication between the different railway stations and intermediate distances. A wire connected with a battery runs from the station to the required distance, one or two miles, or further according to the circumstances, where it joins two bars, placed one on each side of the line, which are charged with electricity. By means of the usual signals, "All right," "Stop," "Clear," and so on, the station-master on the one side, and the engine-driver of each train on the other, are apprised of the state of the line at any particular moment, and enabled to pursue the proper course. Connected with the bars is a treddle spring, which cannot fail to be touched by any train which passes over the spot, and the action of which is such as to set in motion bells at the station, which continue ringing during the whole time occupied by the passing of the train. The signalling appears to be so arranged that it is next to impossible for two trains to enter at the same time on the intermediate ground without wanton disregard of duty on the part of the railway servants in charge of the stations or the trains. Mention also was made yesterday of an apparatus which has been in operation on the South-Eastern Railway for several months; the effect of it being to enable the station-master to prevent any train from starting until a signal has been received announcing that the line is clear. Even this appears to be well adapted to secure the public against a recurrence of many of the most fatal accidents recorded; but if there are no practical difficulties of an insurmountable nature to be urged against the more recent and exact invention exhibited for the first time yesterday, the public will have a right to expect to be saved from having broken bones, and railway companies to be relieved from expenses and compensations and repairs which sometimes have a serious effect on dividends.

Railway Gazette, December 24th, 1853.

A pirvate exhibition and description of a model of an apparatus for signalling from a station to the driver of a train while in motion, the position of a train previously passed, or that the line is clear; and also a station signal, showing whether the line is free from one station to another, took place on Thursday last at Messrs. Ogan and Goddard's, 2, Turnwheel-lane. These desirable results are effected in the most simple manner by galvanic electricity, patented by Mr. Tyer, and appeared to us highly effective. For signalling the driver while his train is in motion, a pair of brass plates, about six feet long, formed as double-inclined planes, are fixed on the rails at any desirable distance, and put in connection with the con-

ducting-wires of the station-battery. On the locomotive is placed an armature and index; beneath the carriage-frame are two metal springs, which, as they pass over the brass plates, complete the circuit; and as the station-master, according to his knowledge, places his index at "down-train," "up-train," meaning they have just passed, and care must be taken, or "line clear," such information is displayed on the index on the passing locomotive. What is termed the "station-signal," is effected by a converse arrangement. An instrument is fixed in front of the station, where it can be seen by all the officials of the railway. At any required distance—say one, two, or more miles, or even including the space between three stations, metallic springs are so fixed by the side of the rails, that the flange of every wheel of the train completes the circuit, and instantly rings a bell continuously at the station in advance during the passage of the train; and also notifies to the station-master, by the index of the instrument, that the line is clear, and enables him to give such information to the driver of the next coming train by the first-described arrangement. It will be seen that the apparatus can be variously modified to meet every kind of casualty, and must prove exceedingly efficacious in the prevention of collisions. One of the instruments for station-signals has been in use on the South-Eastern Railway above seven months, and one for signalling drivers in motion, on the Brighton line, three months, with most satisfactory and effective results. The former is known to have prevented at least three collisions.

Sunday Times, December 25th, 1853.

WE witnessed, on Thursday last, a very interesting demonstration of a new patent invention of Mr. Tyer, for the prevention of railway accidents, by means of electric communication, which appears to us to possess the great *desiderata* of simplicity and unerring certainty in its operation. It consists of an electric battery, of which a wire from the positive and negative poles is carried from the station where the battery is fixed, to any distance along the line—say one or two miles—where two detached brass bars are placed on each side close to and parallel with the rail. Should a necessity arise at the station for stopping any approaching train, the electric battery is put in action, and a current transmitted by the wire to the brass bars on the line. But the electric circle is not complete until the train comes up, the engine of which being furnished with a connecting apparatus, and a spring which passes on each side over and touching the two brass bars, the electric circle is formed and the action communicated to an indicator on the engine, which rings a bell, and may be made to shut off the steam. The station-master has it thus in his power to give instantaneous and certain warning of danger at any distance thought necessary to any train approaching the station, either on the up or down line. A further application on the principle is developed on what the inventor terms the station-signal, by which notice of the approach of a train may be communicated, from the

driver of the engine. It is also intended to apply the invention to prevent accidents to trains by collision while being shunted into a siding, or from one line to another, by connecting the arm of the lever working the points with an electric battery, which would give notice to approaching trains to stop or slacken the speed. We understand that both these inventions are now employed on two of our railways; the South-Eastern having had the station-signal in use for seven months, and the Brighton line the danger-signal for three months past.

Morning Advertiser, January 9, 1854.

If many be the inventions infanted, and many be still wanted, as civilisation progresseth in her levelling course, not one was more required, and whose benefit will be more gratefully felt by humanity in general, than a life-preserving series of "electro-magnetic railway signals," and this we find in the new invention of Mr. Tyer, a gentleman of highly distinguished scientific acquirements and experience, of modest and retiring habits besides, and of whose system we shall give a description, according to what we ourselves saw and examined into with admiration and delight.

This invention consists of an entirely new system of communicating signals to trains at *long distances* (from the stations to which they may be approaching) by the agency of voltaic electricity, enabling the engine-driver to receive the requisite signal long before he can see those at the station to which he may be approaching, giving him instantaneous notice of any obstruction that may be on the line, so that he can stop short, or come on with caution, as the case may require, ensuring safety to the passengers, freedom from loss to the company, by damage, and rendering collision next to impossible. These advantages, combined with *economy, simplicity, and certainty*, render this invention superior to the present uncertain mode of signalling trains, as will be readily understood from the following remarks:—

A train coming towards a station (say, for instance, two miles off), either upon the down or up-line, gives instantaneous notice to the official on duty of the said train's approach, enabling him to make preparation for its reception.

Should any obstruction be upon the line, which obstruction cannot be removed before the train would arrive, he would immediately turn a small handle, when the train, although proceeding at a rate of from ten to sixty miles per hour, would receive (upon a small instrument fixed upon the dome of the engine) notice to *stop*.

The engine-driver would, accordingly, turn off the steam, and pull up, and should he not do so, *immediately* it is turned off *for him* from the station itself. The obstruction may, in the mean time, be removed from the line, in which case the man upon duty would, by another movement of his

handle, give notice to the engine-driver, either to come on with *caution*, or that *all* was *right*, and so come on at his usual speed.

In the event, however, of the line being perfectly free from obstruction, the train at two miles off, will, after giving notice to the station of its approach as above, receive notice (without *any* intervention of the official) that *all's right, i.e.*, supposing that both the up and down lines are free from obstruction, each train will give notice of its approach, and at the same moment receive notice that *all's right*, and thus arrive in safety.

Presuming that the train is now at the station, and after the passengers have alighted, proceeds on its journey, as soon as it arrives past the said station, say again, for instance, two miles, it gives back notice that the line, either *up* or *down*, is *so far* clear, thus enabling the man, whose duty it is to attend to the signalling, properly to signal all other trains upon the same line of rail.

Want of space prevents us from entering further for the present into Mr. Tyer's apparatus, which is not only an admirable invention, but a saving act of humanity. A beautiful model of this new system is open to view every Tuesday and Friday, at three o'clock, at Messrs Ogan and Goddard's, No. 2, Turnwheel-lane, Cannon-street, City, and all those interested or not in railway travelling improvements, should go, see, and judge for themselves.

Times, January 19, 1854.

YESTERDAY a private meeting, over which the Lord Mayor presided, was held at the London Tavern, in order to hear from the inventor of these new railway signals an explanation of them. Mr. Tyer proposes, by the agency of voltaic electricity, to accomplish the following objects:—1. That the train itself, upon entering any station, shall give notice to the station it last left that the line is so far clear; 2, that, upon quitting a station, the train shall transmit a signal to the next station in advance, directing attention thereto by sounding a bell; 3, the transmission of signals from any intermediate point between stations, so that an alarm can be given, and assistance obtained, in the event of a break down, or other stoppage of the line; 4, that the engine-man may be signalled from the station he is approaching at any distance deemed requisite, auxiliary signals and fog detonators being thus rendered unnecessary. The inventor proposes to arrest the attention of the driver by causing his apparatus to sound the steam whistle; and his plan of signals includes a self-acting register, kept at each station, of the exact signals received. He believes that his invention would be found valuable not only at stations, but also at junctions, tunnels, level crossings, watchmen's boxes, in shunting trains, and in other emergencies. These various objects are mainly accomplished by the introduction of two contrivances—the one for establishing communication from the train to the stations on either side of it, the other for signalling from

the station to the driver of an approaching train. The first contrivance consists of a treddle spring, which, pressed by the flanges of the carriage wheels in their passage over it, and establishing thereby an intermittent circuit of electricity through the wire extending to the station, sounds a bell and moves an index on a dial plate there, so as to give the required signal both to the eye and the ear. The second contrivance is a pair of brass plates, forming double inclined planes, about six feet long, and fixed upon the rails, so that metal springs beneath the frame of the engine come in contact with them, when the voltaic circuit is again completed, and signals at once indicated to the driver by an index on his locomotive, by the sounding of his whistle, or even by cutting off steam. The whole apparatus can be applied at any required points between stations; can be adapted to the existing lines of telegraph, and possesses the advantage of being self-acting. Mr. Tyer says that his arrangement of treddles has been satisfactorily tested on the South-Eastern line, and that of signalling the driver on the Croydon. His explanations to the meeting yesterday were well illustrated by working models, and at a time when the best means for preventing railway accidents are regarded with such general interest, this plan for guarding against some of the most fruitful causes of them will, no doubt, receive all the consideration to which it is entitled. The electric telegraph presents facilities for promoting the safety of railway travelling as great, if not greater, than any other agency, and these have hitherto been very imperfectly developed. Mr. Tyer is therefore working in the right direction, but whether his plan can be advantageously adopted can only be decided by experience of its merits.

Daily News, January 19, 1854.

YESTERDAY a number of gentlemen connected, or supposed to be connected, with railways, assembled at the London Tavern, at a private meeting, on the invitation of Messrs. Ogan and Goddard, who have an interest in Tyer's patent railway signals, to receive an explanation of the principles of the invention, and to witness some experiments by means of working models illustrative of its efficiency in preventing the collision of trains, and to that extent decreasing the danger of railway travelling. The Lord Mayor presided.

Mr. Tyer, the inventor, gave in minute detail an explanation of the mechanism and mode of working his apparatus, of which a general description was published in the *Daily News* some weeks ago. The station signal, which, as we before stated, is worked by means of the electro-magnets, the wheels of the engine or train as they pass over the line at a given point—say the entrance to a station—pressing upon a treddle, which, uniting under ground with a coil or line of copper wire, completes the voltaic current, and, acting upon the indicators at the last station passed and the nearest onward, gives in the one case the notice

"Line clear," and in the other "A train on the line," at the same time striking a bell to call the attention of the person in charge. In connexion with this is another signal, also worked by a voltaic battery, for communicating with a train while in motion between stations. At a sufficient distance from the station, say one or two miles, parallel bars are laid down, which, by pressure of the wheels while passing over them, are made, at the option of the person in charge at the station, the entrance to a tunnel, or other place where an impediment may arise, to complete an electric current between the point of danger and an indicator fixed on the top of the engine of the train, warning the engine driver to shut off his steam, and by sounding the break whistle, which it does at the same instant, gives notice to the guard to put on the break. Mr. Tyer stated that the former had been for some months in successful operation at one of the South-Eastern stations, and the other upon one of the engines of the Brighton Company.

The Lord Mayor expressed the gratification he felt at having the opportunity of witnessing the experiments and hearing the explanations which had been given; and Alderman Wilson proposed a vote of thanks to Mr. Tyer, which, having been unanimously accorded, and the usual compliment paid to his lordship for presiding, the meeting separated, without, however, any discussion having been elicited as to the practical merits of an invention which is, to say the least of it, exceedingly ingenious.

Morning Chronicle, January 20th, 1854.

A HIGHLY interesting lecture, accompanied by descriptive experiments, was delivered yesterday at the London Tavern, upon the powers and capabilities of Tyer's electro-magnetic railway signals. They are intended to prevent accidents from collisions, &c., on a line, by giving to each station-master and engine-driver instant notice of all that is taking place between any three adjacent stations, and from their extreme simplicity, comprehensiveness, and efficacy, supply what the public have long looked for, and have a right to demand from the directors of railway companies, provision for their safe conduct along the line, from the many accidents by which so many persons have been such serious sufferers. The batteries are in themselves complete and instantaneous in action, and their arrangement ensures the objects required, for the train itself, upon entering any station, gives notice to the station it last left that the line is so far clear. Upon quitting a station, the train transmits a signal to the next station in advance, and calls attention thereto by sounding a large bell, thereby giving the signal-man timely notice. Signals can be transmitted from any intermediate point or place between any two stations, so that, in the event of a break-down, or other stoppage on the line, an alarm signal can be given to the stations on each side, and assistance be obtained. The engine-driver

can be signalled from the station he may be approaching at any distance deemed requisite, rendering auxiliary signals and fog detonators unnecessary. The signal transmitted to the engine-driver is upon his engine, to which his attention is called by the sounding of a whistle of considerable power. Any neglect of the signal given is at once detected, by a self-indicating register kept at the station showing the exact signal received. In the event of "shunting" at a station, notice is given to the stations on each side; and should any train be approaching, the engine-driver would receive a "danger" signal.

Sussex Advertiser, January 24th, 1854.

THE recent accidents on railways, and the strong conviction that with the increased and increasing traffic on these roads there is a co-existent tendency to an increased number of collisions in the present imperfect condition of railway management, have directed the minds not only of the public in general, but of the engineering world in particular, towards the discovery of some efficient means of remedying the existing state of things. Amongst others whose efforts have been engaged in this direction is Mr. Tyer, a gentleman who has for some time past been occupied in perfecting a system of signals by means of voltaic electricity. Mr. Tyer's invention has, we understand, been tested in part on the South-Eastern and on the Croydon line, in the latter case for a period of about seven months, and the result has been such as to justify him in now bringing it more prominently forward, with a view to general adoption. The objects which Mr. Tyer proposes to accomplish by his invention are—1, That the train itself, upon entering any station, shall give notice to the station it last left that the line is so far clear; 2, that, upon quitting a station, the train shall transmit a signal to the next station in advance, directing attention thereto by sounding a bell; 3, the transmission of signals from any intermediate point between stations, so that an alarm can be given, and assistance obtained, in the event of a break down, or other stoppage of the line; 4, that the engine-man may be signalled from the station he is approaching at any distance deemed requisite, auxiliary signals and fog detonators being thus rendered unnecessary. The inventor proposes to arrest the attention of the driver by causing his apparatus to sound the steam whistle; and his plan of signals includes a self-acting register, kept at each station, of the exact signals received.

The mode by which these objects are sought to be achieved is comparatively simple. For conveying signals from a station to the driver of an engine *in transitu* at a distance, the following is the process. A pair of brass plates about six feet long, formed as double inclined planes, are fixed on the rails at any desirable distance, and put in connexion with the conducting wires of a battery placed at the station. On the locomotive is placed an armature and index; beneath the carriage frame are two metal springs

which, as they pass over the brass plates, complete the circuit; and as the station-master, according to his knowledge, places his index at "down train," "up train," meaning they have just passed and care must be taken, or "line clear," such information is displayed on the index on the passing locomotive. In addition, the contact may, by means of the magnet on the engine, be made to ring a bell, so as instantaneously to attract the attention of the engineer, or to blow the steam whistle. Indeed there would appear to be no reason why the agency might not be applied to shutting off the steam itself. As regards signalling the station, this is effected by an instrument fixed in front of the station, where it can be seen by all the officials of the railway. At any required distance—say one, two, or more miles, or even including the space between three stations, metallic springs are fixed by the side of the rails, so that the flange of every wheel of the train completes the circuit, and instantly rings a bell continuously at the forward station during the passage of the train; and also notifies to the station-master, by the index of the instrument, that the line is clear, and enables him to give such information to the driver of the next coming train by the first described arrangement. By this plan the station-master would be aware of the approach of every train, and, having the remedy in his own hands, would be at once enabled to apprise its driver of any obstruction, so as to prevent all possibility of those collisions which now so frequently arise from the blocking of the line at the stations, either from unexpected causes, or from the ordinary transaction of station "business."

A private exhibition of the invention took place on Thursday last at the London Tavern, at which a considerable number of scientific gentlemen and practical engineers were present. The process was illustrated by working models, conveying an extremely accurate notion of the various operations achieved. It was stated at this meeting that that part of the invention which provides for signalling the arrival of trains to the station-master has been at work for several months on the Croydon line, and that in no instance has it been known to fail; the other portion of the invention has also been satisfactorily tested on the North Kent line.

For the information of those specially interested in such matters we may mention that this invention is being brought out by Messrs. Ogan and Goddard, through whose courtesy we had the pleasure of inspecting the models a few days ago at their offices, No. 2, Turnwheel-lane, Cannon-street. We understand that applications have already been made to these gentlemen on behalf of the French government with a view to the adoption of the process on the French lines. As to the value of Mr. Tyer's invention, time, and the experience gained by its practical working, can only properly decide. So far as an opinion can be formed from the models themselves, and from the statements made, the contrivance would seem well adapted to the objects intended. There is unquestionably a crying want for some better means of signalling between the station-masters and the drivers of engines actually *in transitu* along the line, than has yet been discovered, and Mr. Tyer has

done good service in shewing how so powerful an agent as electricity may be brought to render its valuable aid in effecting such a purpose.

Chambers' Jouarnal February 18th, 1854.

WHILE locomotive facilities are increasing, we see with pleasure that the experiments for increasing the safety of travelling are every day acquiring greater value. A meeting has been held at the London Tavern, to consider the merits of Mr. Tyer's electric railway-signals, which, if verified by further trials, will be highly useful. In the words of the report, the inventor's plan is: "That the train itself, upon entering any station, shall give notice to the station it last left that the line is so far clear: that, upon quitting a station, the train shall transmit a signal to the next station in advance, directing attention thereto by sounding a bell: the transmission of signals from any intermediate point between stations, so that an alarm can be given, and assistance obtained in the event of a break-down, or other stoppage on the line: that the engine-man be signalled from the station he is approaching at any distance deemed requisite, auxiliary signals and fog detonators being thus rendered unnecessary." The apparatus will also sound the steam whistle, and keep a register of the signals; and all this is to be accomplished by galvanic agency and the wheels of the engine. The latter, in certain places, press a system of springs which open or close the circuit.

Art Journal.

THOSE important preventives of danger have recently been much improved. Mr. Tyer's patented signals evolve a new system of communication with trains at long distances, by the agency of voltaic electricity, enabling the driver to receive a signal long before he can see those at the station to which he may be approaching; it will thus enable him to be cognisant of danger two miles distant, and stop a train when going at its fastest speed. The indications being made by words, not signs, error is avoided, and its improvement over the present system also consists in one code of signals being used under all circumstances.

Builder, March 25, 1854.

A CHATHAM correspondent, Mr. J. P. Rickon, C.E., speaks of a new self-acting signal, just patented by a Mr. Tyer, and called the "Electro-Magnetic Railway Signal," of which it is said that by this invention, and the agency of voltaic electricity, the train itself, upon entering any station, gives notice to the station it last left that the line is so far clear. Upon quitting a station, the train transmits a signal to the next station in

advance, and calls attention thereto by the sounding a large bell, thereby giving the signal-man timely notice. Signals can be transmitted from any intermediate point or place between any two stations, so that in the event of a break-down, or other stoppage on the line, an alarm signal can be given to the stations on each side, and assistance obtained. The engine-driver can be signalled from the station he may be approaching at any distance deemed requisite, rendering auxiliary signals and fog detonators unnecssary. The signal transmitted to the engine-driver is upon his engine, and his attention is called by the sounding of his whistle. Any neglect of the signal given is at once detected, as a register is kept at the station of the signal received. In event of "shunting" at a station, notice is given the stations on each side; and should any train be approaching, the engine-driver will receive the *danger* signal. It is also applicable to all stations, crossings, junctions, tunnels, &c. All of this, according to our correspondent, has been done by this apparatus, on the North Kent line, between Lewisham and Blackheath. "I have no other motive," he adds, "in writing this beyond the wish of seeing the different companies compelled to adopt some effectual means for the public safety." The apparatus described, he says, has been exhibited in town, at the offices of Messrs. Ogan and Goddard.

Cours Général des Actions, Sept. 7, 1854.

Le système inventé par M. Tyer a été expérimenté sous la direction de M. Barlow, chef d'exploitation du Chemin de Fer South Eastern, en Angleterre, pendant huit mois. Dans un rapport fait par M. Galton par ordre du Gouvernement Anglais, sur les moyens d'empêcher les accidents sur les Chemins de Fer, il recommande ce système à l'attention de MM. les Ingénieurs des Chemins de Fer dans le Royaume-Uni de la Grand-Bretagne.

Des expériences de ce nouveau système de signaux électriques ont été faites en France, sur le Chemin de Fer de Saint-Germain et sur celui du Nord; mardi, 5 septembre, une dernière expérience très-concluante a eu lieu à Paris, à la gare du Chemin du Nord, en présence d'administrateurs de Chemins de Fer, d'ingénieurs et de notabilités de la presse.

On sait que le passage d'un courant électrique autour d'un morceau de fer doux, à angles droits, produit, ou bien attire de fortes propriétés magnétiques.

On place un appareil ayant les mots: *train* et *tout est bien* à chaque station. Une indication ou aiguille est placée sur cet appareil, et se trouve attirée par la bobine magnétique à l'intérieur, à l'une ou l'autre direction selon le courant électrique.

A l'extérieur de chaque station on place une pédale à ressort ajustée de manière que chaque roue du convoi exerce une pression sur le ressort, établissant un contact qui imprime un mouvement de la pile à l'appareil, ce qui produit les effets suivants:

1. Un coup de sonnette à la station suivante, annonçant que le convoi est en marche et avance, ce qui permet aux employés de se préparer pour son arrivée ;

2. L'indicateur, à la station précédente, vien de signaler : *la voie est libre ;* à la station d'où part le convoi, l'indicateur indique : *train*, et, au même instant, la sonnette donne avis à la station suivante.

Quand le chef de la station reçoit le signal par la sonnette, il regarde immédiatement l'indicateur, et si ce dernier indique : *la voie est libre*, il permet au convoi annoncé de s'avancer ; si, au contraire, l'indicateur est dirigé vers le mot : *train*, en tirant la manivelle de l'appareil à sa station, il communique à l'indicateur fixé sur la locomotive le signal : *arrêtez ;* mais aussitôt que l'indicateur de la station indique ; *la voie est libre*, en renversant la manivelle indiquée ci-dessus, le mécanicien qui conduit la locomotive reçoit le signal : *tout est bien ;* il sait alors qu'il peut avancer avec sécurité et continuer sa route.

Par une combinaison fort simple, quand le signal *arrêtez* est donné, le conducteur de la locomotive peut arrêter instantanément la vapeur ; par ce mode très-simple, on peut donc prévenir tout accident.

Morning Post, Nov. 17, 1854.

Some experiments have lately been made of a new system of electric signals at the Paris station of the Northern Railway. An apparatus having the words *train* and *tout est bien* is placed at each station. An indication, or hand, is placed in this apparatus, and is attracted by the magnetic power on the inside, in one or the other direction, according to the electric current. On the outside of each station is placed a pedal, with a spring adjusted in such a manner that each wheel of the train presses on the spring, thus establishing a contact which gives a movement of the pile to the apparatus, and produces the following effect : 1st. A ring of a bell at the next station announces that the train is advancing, by which means the employés prepare for its arrival ; 2dly, the indication to the preceding station having just signalised *la voie est libre*, it allows the announced train to advance, if, on the contrary, the hand points towards the word *train*. In drawing the handle of the apparatus at its station, it communicates to the indication fixed on the locomotive the signal *arrêtez ;* but as soon as the indicator at the station shows *la voie est libre*, by reversing the handle above mentioned, the engine-driver receives the signal *tout est bien*, and he then knows that he may advance with security. By a very simple combination, when the signal *arrêtez* is given, the engine-driver can immediately shut off his steam, so that all accident may be prevented.

See also an article by M. l'Abbé Moigno, in "Cosmos," Sep. 15, 1854 ; "Ainsworth's Magazine," &c., &c.

RAILWAY COLLISIONS PREVENTED.

CHAPTER I.

THE RISE AND PROGRESS OF STEAM-POWER AND OF RAILWAYS.

"Soon shall thine arm, unconquered steam, afar
Drag the slow carriage, and impel the rapid car."
Prophecy of Dr. Darwin, about 1780.

It is not intended to enter at any length into the history of Railways, or of steam locomotion in connection therewith, but simply to give a brief narrative of their progress, and especially to exhibit the rapidity with which the former have attained the vast influence which they exercise upon the welfare and condition of the nation at the present day, and afterwards to trace the principal causes of the many accidents which have unfortunately occurred since their introduction, and to suggest a simple and practical remedy, by means of which they may be in future, to a great extent, if not entirely avoided.

More than 2,000 years ago, the attention of Hero, a mathematician of Alexandria, (contemporary with Archimedes,) was directed to the power of steam, and its applicability as a prime mover. The simple apparatus invented by him, (B.C. 209,) in order to demonstrate his discovery, consisted of an iron cauldron, or boiler, from which the steam passed through hollow tubes turning a globe fixed at the top of the boiler.

In 1624, De Caus, a French mathematician, applied this power to the purpose of raising a jet of water for fountains.

In 1629, it was first employed to machinery by Giovanni Branca, an Italian philosopher. The apparatus invented by him, consisted of a vessel, over a boiler, having tubes fixed thereto, through the orifices of which, the steam rushed against the floats of a wheel (similar to the paddles of a steamer) which was driven round by the force of the vapour; attached to this wheel was a pinion giving motion to any machinery with which it was put into connection. From this date to 1781, the Marquis of Worcester, Sir Samuel Moreland, Captain Savery, Smeaton, and others, severally directed their attention to the subject; but it remained for James Watt, an engineer of Soho, Birmingham, (who was born at Greenock in 1736,) to contribute such improvements as enabled steam power to be applied to useful purposes. A "portable steam engine, and machinery for moving wheel carriages," was invented by him in 1784. The honour of inventing and introducing the first "Locomotive Carriage," or "Carriage by Steam," is however due to Mr. Blenkinsop, an engineer of Middleton Hall, near Leeds, who made his first successful experiment in 1804, and in the same year, his locomotive was in active operation at a mine at Merthyr Tydvil, in South Wales, drawing on the occasion of its first trial, carriages containing ten-and-a-half tons a distance of nine miles, at a rate of five-and-a-half miles per hour!

The earliest approach to a Rail-road of which notice is made, consisted of stone tram-ways laid down at Newcastle-upon-Tyne in 1676, to facilitate the passage of waggons, heavily laden with coals from the collieries. The use of stone was continued until 1736, at which time wood was substituted, iron not having been employed for the purpose until 1767, when the Colebrook Dale Company laid down some rails for the use of their works in Shropshire. In 1782, Sheffield contributed her mite to the slowly developing system; it was not however till 1825, that Railways began to acquire any important commercial position. In 1820, the "Stockton and Darlington Railway Company" was incorporated by Act 1 and 2 Geo. iv., c. 44, for the formation of an iron tram-road from the river Tees, at Stockton, to the Wetton Park Colliery, with power to make branches therefrom. This Railway was commenced in 1823, and was

opened for coal traffic on September 27th, 1825, the length being 40 miles, and the cost about £15,000 per mile, locomotive steam power being employed instead of that of horses. About the same time, (1820,) the "Stratford and Moreton Company," also obtained an act of incorporation (1 and 2 Geo. iv., c. 63,) for a Railway from Stratford-on-Avon to Moreton, in Gloucestershire, a distance of 16 miles, which was opened in 1827, the construction having cost nearly £70,000.

In 1822, a company was projected by a Mr. James, an engineer of London, and an unsuccessful application was made to Parliament in 1824, for powers to make a line between Liverpool and Manchester. The Company, nothing daunted by the previous defeat, continued their efforts, and in 1826, obtained an act (7 Geo. iv., c. 49,) after a most vigorous opposition thereto by the Earls Derby and Wilton, and also by the Marquis of Stafford.

It appears that for some time after this project was commenced, it was undecided whether to apply horse power, fixed steam engines, or locomotive engines as a means of transport, and no idea was entertained of employing Railways in any other manner than for the carriage of goods. It was in 1829, that the Directors of the Liverpool and Manchester Railway first determined to apply the power and facilities which they would shortly possess, to the conveyance of passengers to and from those towns. In April of that year, they advertised a premium of £500, for the best locomotive engine, the weight not to exceed six tons, and to be capable of drawing three times its weight, at the rate of not less than 10 miles an hour; no smoke was to be produced, and the pressure of steam was limited to 50 lbs. on the square inch; the engine was to be supported on springs, and the height was not to exceed fifteen feet. Three engines, the "*Rocket*" constructed by Mr. Geo. Stephenson, the "*Sanspariel*" by Mr. Hackworth, and the "*Novelty*" by Messrs. Braithwaite and Ericson, were entered for the contest, which took place at Rainhill on the 6th October, 1829, the result being that the premium was awarded to Mr. George Stephenson, whose engine, the "*Rocket*," was the only one which succeeded in performing all the conditions imposed; this

engine accomplished the stipulated distance of 70 miles in less than six-and-a-half hours, including forty stoppages which it was compelled to make, in consequence of the trial taking place on a piece of road a mile and three quarters in length, the weight of the engine, &c., being as under, viz :—

	Tons	cwt.	qrs.	lbs.
Engine "Rocket"	4	5	0	0
Tender, with water and coke	3	4	0	2
Two carriages loaded	9	10	3	26
Total tons	17	0	0	0

During the trial, a speed of from 18 to 20 miles an hour was frequently attained.

Here, then, was the first great step in advance, towards our present system of travelling, an important end accomplished, a new era commenced!

The Manchester and Liverpool line having been completed by Messrs. Stephenson and Locke, at a cost of £1,089,818, was finally opened to the public on the 15th September, 1830, the late Duke of Wellington attending the ceremony. It is from this time also that we have unfortunately to date the first of the numerous "Railway Accidents" which have since occurred from employing the powerful agents which had so recently been introduced to our use. On that most important but fatal day, Mr. Huskisson was run over and killed, depriving England of one of her most eminent statesmen, whilst assisting by his presence in the inauguration of a work, destined to become the forerunner of many similar undertakings, by which the power and wealth of the nation have been rapidly increased, and its commercial and social welfare advanced to an almost incredible extent.

From that time to the present, the attention of scientific men has been continuously engaged upon the subject, with what surprising and important results, need not here be told.

The requirements of commerce, the large increase of population, the discoveries in science, and the general advancement of civilization, have led to an enormous amount of personal locomotion previously unknown, and which continues to increase day by day, as greater facilities are afforded to the public. At the present date, there are in the United Kingdom 7,686 miles of

Railway already open for the traffic of goods and passengers, and 883 miles are in the course of construction.* The one locomotive of 1804, has become the progenitor of nearly 4000 "fiery messengers," daily travelling on their several peaceful and prosperous errands, at a speed varying from 15 to 60 miles per hour!

To have a just and proper appreciation of the benefits resulting from the introduction of Railways, it is only necessary that we should glance at the means of transit existing at the time when the first small step was taken in 1676, towards that grand system which now grasps England in its length and breadth with "roads of iron." At that period, the *very best* and *most important* highways were in an extremely wretched condition, at all times several feet deep in mud and mire, abounding with holes, and frequently covered with water, rendering them impassable, except in fine weather, for the waggons and pack horses, by which the goods and passengers were ordinarily conveyed, and then only at an enormous expenditure of time and money. A few years afterwards (1689) saw the introduction of stage coaches, which travelling at an average rate of 40 miles per day, and occupying five to six days in journeying from London to York or Exeter, (the utmost limits yet ventured upon,) were considered to be so dangerous to the public interest from their excessive speed, that several petitions were presented to Parliament to restrict their future rate of travelling to 30 miles per day.

A short 25 years back, just previous to the opening of the Liverpool and Manchester line, and within the recollection of many now living, with good macadamized roads, and all the improvements effected by a persevering and practical people during 144 years, the performances of the Brighton "Age,"

* The Capital invested therein, up to 31st December, 1853, being £273,324,516, 6*s.* 9*d.*, namely :—

	£	*s.*	*d.*
Share Capital, paid up.....	208,251,557	13	10
Loans.....	65,072,958	12	11
	£273,324,516	6	9

between London and that town in five hours, and of the "Defiance" between London and Exeter in thirty hours, were looked upon with wonder, and excited the especial admiration of all travellers, who considered that the very perfection of travelling had been attained. And yet, in about one-third of the allotted term of man's brief existence, by the aid of science, and the ingenuity of the human mind, the same distances are traversed in one-fifth the time, with far less trouble, fatigue, or expense. Who, after such results, will dare to prescribe the boundaries to these most wonderful and valuable inventions, or the limits to man's genius, when exploring the arcana of science?

CHAPTER II.

THE CAUSES OF ACCIDENTS UPON RAILWAYS.

"If I find not what I seek, show no colour for my extremity."
Merry Wives of Windsor.

"Nothing extenuate,
Nor set down aught in malice."
Othello.

Railways, in common with every other mode of travelling which has at any time been adopted, have not been free from accidents. The number, however, occurring thereon are much less in proportion to the miles traversed, and the daily amount of traffic over them, than happened under the old system of stage coaches, &c.; but, from the nature of the agent employed, the accidents which do occur are generally most calamitous to life and limb, and destructive of property to an enormous extent.

By the 3 and 4 Vict., c. 97, (1840,) and subsequently by 6 Vict., c. 55, (1842,) power is given to the Board of Trade to "require of Railway Companies returns of all *serious* accidents,

whether attended with personal injury, or not." The exact number of *all* accidents occurring is not, therefore, stated in these returns, but they are sufficiently correct for the present purpose.

It appears that during the six years ending 31st December, 1852, the number of persons killed and injured from accidents reported to the Board of Trade, was 2,917, *viz.* :—

Killed	1,063
Injured	1,854

From the 1st January, 1853, to the 31st December of the same year, there were 103 accidents to the trains and engines, of which 76 were considered sufficiently "*serious*" to be brought to the notice of the Board of Trade by the inspecting officers. The total number of persons, who suffered in consequence of these 76 accidents was 754, *viz.* :—

Killed.....	305
Injured	449

During the six months from 1st January, to 30th June 1854, these numbers have been increased by 46 accidents, by which there were—

Killed	100
Injured.....	119

In analyzing these last 122 accidents, we find that no less than 66 arose from *collisions* between trains, or rather more than 54 per cent. of the accidents from all causes. To the consideration of these fruitful sources of danger will we therefore direct our attention.

It appears, by the report furnished by Captain Galton, R.E., to the Lords of the Committee of Privy Council for Trade, that these collisions were attributable more or less to the following causes :—

1.—*Inadequate signals.*

2.—*Unpunctuality.*

3.—*Defective system for securing a proper interval between trains.*

4.—*Trains shunting at sidings or stations.*

The system at present adopted on nearly all the lines of railway, is to have fixed at each station a post having two

folding arms, (known as a "semaphore,") which is used for giving signals to approaching trains, both on the up and the down lines; and it is the custom, so soon as a train has entered a station, for the signal-man to extend one of these arms at right angles with the post, intimating "*danger*" to any approaching train. This signal is repeated at a distance down the line, on another semaphore placed there for the purpose, in order that the signal may be observed by the driver of a succeeding train at a long distance from the station. After this signal has been continued for *five* minutes, its position is altered to an angle of about 45 degrees, which implies that the driver *may proceed with "caution."* A further interval of *five* minutes, making *ten* minutes in all since the passing of the train, is permitted to elapse, when the arm is lowered into the post, and this conveys to the engine-driver that "*all is right,*" and that he can continue his route at his usual speed. At night, lamps with various coloured lenses are employed for the like purpose.

Red, implying "Danger,"
Green, „ "Caution,"
White, „ "All right."

The slightest consideration of this system will show that it contains within itself the *elements of danger.* The permission for a succeeding train to proceed, is given after a specified *time* has expired since the preceding train has passed, *without reference to the comparative speed at which they may be travelling*, or to the *possibility* of an accident having occurred to the earlier train from a broken axle, or otherwise.

If *time* is to be the guide to the signal-man, it follows as a *necessity*, that every man so employed, or who may in any way have to regulate the departure of the trains, should be provided with the means of measuring that time correctly, and not only so, but that he should consult the time-piece provided him, or how is it possible that the semaphore signal can be worked accurately? Numerous are the complaints made by the Government Inspectors, that the servants of several companies *are not supplied with watches*, but it will be seen by the following extract from the report of Lieutenant

Tyler, R.E., (one of the Inspectors of Railways,) to the Railway Department of the Board of Trade, (under date January 10, 1854,) relative to a collision which occurred between two trains on December 29, 1853, on the Lancashire and Yorkshire Railway, that the time-pieces (when provided) are not always consulted, but that the signals are turned through their several phases by *guess-work*. Is it too much to infer that at times they are neglected entirely? but here is evidence of the laxity and recklessness displayed:—

"It is not possible," (writes Lieutenant Tyler,) "to ascertain the exact interval between the departure of the trains either from Manchester or Miles Platting, *on account of the culpable negligence of the Company's servants in not consulting their clocks.* The station-master at Manchester observed that the Rochdale train started exactly at 9.45, as he *happened to be opposite* the clock at the time; and he allowed the Oldham express to follow it, at an interval which he *considered* to be more than *ten* minutes; BUT HE DID NOT TAKE THE TROUBLE TO LOOK AT THE CLOCK, and he states that it is his CUSTOM to start trains one after another, without ascertaining from the clock that there is a proper interval between them. The signal-man at Miles Platting junction, whose duty it is to exhibit the danger signal for five minutes after the passage of the Rochdale train DID NOT LOOK AT THE CLOCK provided in his cabin, but BELIEVES that the Oldham train must have passed him *ten* minutes after the other train. The station-master at Miles Platting, whose duty it is to see that the danger signal is exhibited for *five* minutes after the passage of a train, *was not more particular.*"

Several other instances might be given, if necessary, to show that although TIME is the standard for the starting of trains, yet that it is continually disregarded, either from "culpable negligence," or the want of means of measuring it, although such neglect might possibly be attended with fatal consequences.

But suppose the signal-man, station-master, and other officials, to be at *all* times most attentive to their duties, still, under this arrangement, collisions *may and do* occur. Let us imagine a case where the regulations of the Company require that an interval of FIVE *minutes* should be maintained between the passage of every train past a particular spot. A train travelling at a speed of 18 miles per hour has

passed the signal-post; at the end of the five minutes it will have reached a distance of one-and-a-half miles, when an "express" train, travelling at say 40 miles per hour, also passes at the proscribed interval of FIVE minutes. Is it not clear that the latter will overtake the former before it has proceeded far upon its journey? Here is an illustration:—

On January 24, 1853, a collision between a passenger train and a cattle train occurred near the Chorley station of the Lancashire and Yorkshire Railway. The Report of Captain Galton says—

"That the cattle train left Preston at about 4.35, P.M., and passed the Euxton junction at 4.55, P.M. *At this junction, the rule is observed of showing the danger signal for five minutes after the passage* of a train, and the cautionary signal for the following five minutes * * * * The cattle train travelled something *over* 18 miles per hour * * * * * * The time at which the passenger train passed the Euxton junction was 5.15. * * * * The passenger train overtook it and ran into it."

In this case, *twenty* minutes had elapsed between the cattle and passenger trains passing the signal-post at the Euxton junction instead of FIVE, but withal the cattle train was overtaken, "and run into."

Another, and a very strong objection to regulating the intervals between the passage of trains by TIME, is that there is no surety that the first train has not met with an accident, or been delayed after leaving the station; in such a case, the succeeding train may have been detained by the semaphore signal the allotted time, and yet afterwards overtake the preceding one. We will give an example or two:—

On the 5th October, 1853, a collision on the "Great South Western Railway," (Ireland,) occurred between an express passenger train and a goods train, by which 15 persons lost their lives, and five others were seriously injured, besides a considerable amount of property destroyed.

Lieutenant Tyler, R.E., reports:—

"That the express train was brought to a stand in consequence of the breaking of one of the pistons * * * *The goods train dashed into the other with a crash," &c., &c.*

On the 23rd November, 1853, a collision occurred near the Leicester station of the Midland Railway, by which several persons were injured. Lientenant Tyler's Report says :—

"It appears that the coal train was unable to proceed at a greater rate than four or five miles an hour, when within about one mile and a half of Leicester, *on account of the disabled state of its engine*, and that it was overtaken and run into by the mail passenger train."

On the 14th December, 1853, a collision occurred between two coal trains in the Stoke tunnel of the "Great Northern Railway." The Report of Lieutenant Tyler, R.E., says :—

"Three trains left Corby for Grantham in the following order, and at the following times :—

1. A goods train at 12.30, p.m.
2. A coal train .. 12.35, ..
3. A coal train .. 12.45, ..

The driver of the *first coal* train, followed the *goods* train *closely up to the mouth of the tunnel*, and the tunnel being so full of steam and smoke as to prevent his seeing any distance before him, he proceeded through it at a *cautious* speed. * * * * Whilst so proceeding, his train was run into by the *second coal* train, when about two-thirds through the tunnel, and the guard of the first coal train was seriously injured."

It will be observed that an interval of *five minutes* only had elapsed between the starting of the first and second trains, whilst the *full* TEN *minutes* had expired between the second and third. It was impossible for the driver of the second coal train to avoid the collision. The "caution" speed used by him was doubtless the *secondary* cause of the accident, but it is clear that had he increased his rate of travelling, the first train would have been overtaken, and run into by the second, and with a fair probability of a *second collision* by the arrival of the third train; the *primary* cause is traceable to the interval having been regulated by TIME.

A very great deal of additional evidence might be adduced, but the foregoing will be sufficient to prove that such occurrences have been frequent, and that the interval of TIME is not a sufficient guarantee against accident.

Collisions also frequently take place through *shunting*, and there are no less than six reported as having occurred during

1853; but the following will suffice to show the necessity of some arrangement, which shall prevent the recurrence of similar misfortunes :—

On the 31st August, 1853, an express train came into collision at Hornsey, on the "Great Northern" line, with a portion of an up coal train, "which was in the act of being shunted across the line at the time the express reached the station."

The whole of the before-mentioned accidents might have been avoided, had a system of measuring the intervals by *distance* instead of *time* been adopted; but of this we shall have more to say in describing the means to be employed for the prevention of these sad calamities.

We cannot, however, quit this part of the subject, without referring to the numerous accidents which have happened in consequence of the semaphore signals exhibited at the stations, not having been seen by the drivers of the trains for whose instruction and guidance they are especially provided; we will content ourselves by selecting from a host of similar cases, a few of the reasons assigned by the Government Inspectors, &c., for those signals being passed unnoticed, without waiting to distinguish the several accidents which arose therefrom.

1.—"It is stated that a *snowstorm was beating in the driver's face* at the time of the accident."

2.—"The accident was caused by the neglect of signals by the engine-driver of the coal train. From the man's own statement, he appears *to have been engaged in attending to some part of the machinery, and the fireman was heaping on coals as they approached the siding.*"

3.—"The morning is described to have been *so foggy, that it was impossible to see more than* 20 *yards.*"

4.—"The *fog* was so dense, *that an object could not be seen* 100 *yards off.*"

5.—"The *fog* was then so thick, *that the driver and guard could not see each other.*

6.—"It appears that the driver, as soon as he got out of the station, began blowing steam through the cylinders; the engine was in consequence *so involved in steam, as to render it impossible that he could see the danger signals* that were made to him."

7.—"It is most true, that the signal-post is liable to be interrupted by fog, rain, or snow, *a defect which it possesses in common with all signals that appeal to the vision.*"

This last is a most important admission, coming as it does from the *Manager* of the "Caledonian Railway," and proves, taken with the others, how totally inadequate the semaphore signals are upon extraordinary occasions, to the purposes for which they are intended, the very times when good signalling becomes absolutely necessary, and really valuable. It is true, that in misty weather or at night, "fog detonators" are employed in order to give notice of any accident or delay which may have occurred; but were it not for the space which the particulars would occupy, numerous proofs could be afforded of their not being effectual at all times, and consequently not to be depended upon as a means of avoiding or preventing accidents. Frequently, when required the "fog-detonators" were not at hand; and if otherwise, then the time has not in many cases been sufficient to allow the guard to place them on the rails at a proper distance to stop a coming train.

CHAPTER III.

HOW COLLISIONS MAY BE PREVENTED.

King.—Upon thy certainty, and confidence,
What dar'st thou venture?
Helen.—Tax of impudence.....

All's Well that Ends Well.

HAVING ascertained that the majority of railway accidents arise from collisions, let us consider how they may be prevented. Our first enquiry will be therefore,

What is a collision?

Dr. Johnson defines it as an act of striking *together*. Now this word "together" is a key to the whole; it provides that in

order to effect a *collision, two* bodies must be brought *into contact with each other.* It is therefore utterly impossible that a collision can occur between *two* trains with *one* train only, and it follows by a parity of reasoning, that if a *second* train is always kept at a certain distance of "space" apart from a preceding train, and that *under no circumstances whatever* it be permitted to lessen the limit fixed upon as necessary to exist between them, the "*striking together,*" or "*collision*" of two trains cannot occur.

In order to provide for this, it is necessary that the line of Railway should be divided into certain portions, say *A, B, C,* which for convenience we will consider to be the ordinary stations. Upon the arrival of a train at *A,* notice should be given to *B* of the same, enabling the officials to prepare for its approach; upon receipt of this notice, *B* must communicate with *A* whether the "*line is clear,*" or otherwise, to that station—(*i.e.*, whether a preceding train has passed that station or not)—the train at *A* not being allowed to proceed until a notification of "*line clear*" has been received from *B.* Upon the train reaching *B,* the same interchange of cautionary notices or messages should be made with *C,* and so on along the whole line.

It is clear that if this order be preserved, a collision would be utterly impossible, whether from *deraillement* of the train, unpunctuality, excess of speed of one train over that of another, delays arising from the bad state of the weather, deficiency of steam power, defective machinery, or *from any other cause* whatever. In this we are supported by the opinions expressed by the Government Inspectors on this proposal.

Capt. Wynne, R.E., on the 11th October, 1853, says :—

"No train should be allowed to pass a station until it had been telegraphed back that the preceding train was clear of the station next in advance. Such a plan faithfully carried into execution, *would render collision impossible,* except under very peculiar circumstances."

Capt. Galton, R.E., under date 27th September, 1853, writes:

"It appears to me that the most efficient mode of securing an interval between trains, *and of doing away with any possibility of collision* to trains

between stations is, to divide the railway *into portions, and not to allow a train to enter upon one portion until the preceding train shall have left that portion.* The length of these portions would be regulated by the amount of traffic."

Again, under date 5th December, 1853, he says :—

"It shows how impossible it is practically at all times to preserve trains from collisions, when their safety depends alone upon the *interval of time* which elapses between the *starting* of the trains; and it adds another argument to the many which already exist in favour of adopting a system of working all trains, in which the interval between trains following each other on the same line of rails is one of distance between the trains, instead of an interval of time between the starting of the trains."

The question however arises, how the needful communications between the stations can be effected with sufficient speed and accuracy, so as to avoid any unnecessary delay in the working of the traffic, and at the same time to ensure a perfectly safe conduct to the succeeding train? The facilities afforded by electricity remove all the difficulties which might otherwise have presented themselves in the above shape, and we will presently show that a *modification* of the electric telegraph will answer all these very desirable ends.

The opinions of the Government Inspectors are valuable, as they are the results of great experience, and mature consideration of the several causes of accidents painfully forced upon their attention, in the discharge of the duties entrusted to them by the Government. Such statements as the following are therefore deserving of the greatest respect, as evidencing the necessity of providing a better means for the prevention of accidents to trains whilst "shunting."

Capt. Wynne, R.E., on the 11th October, 1853, writes :—

"Accidents arising from shunting operations, when carried on but a short time in advance of express trains being due, have been of such *frequent* occurrence, *even with the danger signals duly displayed,* that railway authorities ought at length to be convinced of their uncertainty as safeguards against danger, and be induced to regard the best arranged system of signals, as but auxiliaries to safety."

Lieut. Tyler, R.E., on the 30th November, 1853, writes:—

"One of the *most fruitful sources of accidents* is the allowing trains to be shunted across the main lines of a railway when other trains are due."

It may perhaps be argued, that to issue a positive order against shunting when another train is nearly due, would amount practically to a total cessation of the business of the line at many stations, and in this we perfectly agree: our remedy therefore must be sought for in another direction. With the assistance of the telegraph, nothing can be easier or more effectual than that whenever *shunting* operations are about to be performed, notice should be sent to the station on either side, so that approaching trains may be stopped, from whichever direction they may be coming, until a message had been communicated to the station "shunting," when the line would be cleared, and the operations deferred until the train had passed. The only delay which would thus arise to the train, would be the short time occupied in clearing the line; and to the *shunting*, that of the time occupied in the transit of the train between the two stations; DELAYS ABSOLUTELY NECESSARY, if the safety of the train and its passengers is at all to be considered. Immediately after the departure of the train, the shunting could be recommenced, notice being first given to the station on either side to stop both up and down trains whilst the operation is continued, and as often as a train arrived at either of the stations whilst the line was "stopped," a telegraphic message would procure a removal of the obstruction, when the train might be permitted to proceed, the line being again "stopped" upon resuming the work. In this way little or no time would be lost, *and to act in any contrary manner would be only to court danger.*

As frequent instances were given in the preceding chapter, of the semaphore signals having been passed by engine-drivers unnoticed, it may perhaps be considered unnecessary to add thereto, but we cannot refrain quoting from the evidence of Mr. George Hawkins, traffic-manager of the Brighton and South Coast Railways, given at the Coroner's Inquest held in consequence of the late lamentable accident at Croydon, in proof of the inadequacy of the present system. That gentleman says:—

"No doubt a better system than that now in operation might be used to signal the departure and approach of trains. * * * * Much however depended upon the state of the weather. Two Engines *passing each other* a little to the south of the station might obscure the signal, but it would only be for a moment. The *two bridges obscured* the semaphore signal for a moment or two, while the train traversed a distance of 187 yards, and the *smoke and steam might further obscure* it. The signal had not, however, been complained of as inefficient."

Unfortunately complaints of the inefficiency of signals are rarely made until such inefficiency has been painfully and forcibly PROVED by an accident occurring.

The above extract from the evidence of Mr. Hawkins shows that it is not only "*fog, rain, or snow,*" which prevent the signals being seen, but that it sometimes happens from other causes. Captain Barlow, the General Manager of the South Eastern Railway, deposed upon the same occasion to the effect that having on the following day walked up that portion of the line at which the accident occurred, *he lost sight of the semaphore four times*, in consequence of the sun shining strongly upon it over the Norwood Hills.

It will be readily understood also that a signal post may be passed unnoticed by either the driver or the fireman, whilst performing any of their duties in connection with the engine.

At night, or in fogs, lights are employed, as before stated; but it has been frequently known in country districts for these lights to burn dimly, *and go out altogether* in cold weather, from the oil having been frozen, and lately an accident occurred in consequence of the signal-lights having been blown out by the force of the wind during a severe tempest.

Again, it sometimes, and we fear ofttimes happens, that engine-drivers and firemen take it in turns to keep the "look out," whilst the other sleeps on the engine, and thus signals have been passed unnoticed, when the attention of the "look out" has been directed to the state of his fire, or to similar matters.

From the foregoing, it appears absolutely necessary that some more certain mode of signalling the driver of an engine, than that at present employed, should be adopted, so as to prevent the possibility of any mistake occurring, or of the signals not

being seen. The opinion of Lieut. Tyler, R.E., on this subject is worthy of quoting here. He says:—

"Accidental stoppages to trains must be expected to arise at times, and the means to provide for the safety of both the stopping train, and the one following it, should never be wanting. Those means should be the *simplest*, the *readiest*, and the *most certain* that can be devised."

The proposal before made, of not permitting a train to pass a station, until previously advised that a preceding train had arrived safely, and departed from the station in advance, fully provides for the safety of both the trains, in the event of any "accidental stoppage" occurring, *provided* that a communication can be made with the coming train, in sufficient time for it to stop, and that the signal is such as can be seen.

Any system of signalling trains which may be proposed, should therefore contain, as a *sine qua non*, the following conditions:—

1.—Each station should be enabled to communicate readily with the station on either side of it, so as to announce the approach and departure of every train.

2.—The agent employed should be that of electricity, as being the "*readiest*" and "*most* certain" in its operation.

3.—The telegraph instrument used, should be of the "simplest" form, not liable to derangement; and the manipulation of it so easy and intelligible, that the veriest novice may at once understand the operation thereof.

4.—The signal should not consist of arbitrary signs, but be given in plain language, such as "line clear," or "line stopped."

5.—The person *receiving* the signal, should have no means or power of altering it; the person or station *transmitting* the signal, should alone be enabled to reverse it.

6.—The signal once given, should remain *fixed* until the next signal be sent, so that both the *sender* and *receiver* should have the means of referring to it, and ascertaining at any time the state of the line, and the *last signal* forwarded.

7.—The signal from a station to an engine-driver should be given *upon the engine* whilst travelling, and in such a manner that it cannot possibly escape his notice, and ready means of effecting

this communication with him at several parts of the line between each station, should also be afforded.

8.—It should be *distinct* and *positive* in its instructions, either of "*All right*" or "*Stop*," *so that the meaning cannot be mistaken.*

9.—An alarm should be given to the driver each time a signal is sent, so as to direct and ensure his attention thereto.

10.—The guard of the train should receive in his van a similar signal to that sent to the driver.

11.—A register of the signal *received* by the driver and guard should be recorded, with the sender, to prove that it had been duly received.

12.—It should be such an arrangement as could not be interfered with by others than the proper officers of the Company, to whom the management of the trains is entrusted.

13.—The person sending the signal should have the power of stopping the engine, if the driver neglects the signal.

14.—In the event of an axle breaking, or a stoppage of the train from any other cause, means should be provided by which the guard may be enabled to communicate instantly with the station on either side of him, without having to leave his train for any distance.

If these "conditions" be carried out, every train would be always placed, as it were, under the guardianship of *three* stations, *viz.*, that in advance, that at which it had arrived, and that in the rear, a constant communication would be kept up from each train to the several stations *en route*, and *vice-versa*, from each station to the train, rendering collisions *absolutely impossible*, except from *wilful neglect*, in which case the actual offender *would be at once discovered*, and be made to bear the responsibility of his misconduct; this being so, we need scarcely say would ensure greater attention to their duties from all the officials and *employés*.

How these great *desiderata* may be accomplished, will be described in the next chapter; it will be sufficient here to say, that the means employed have all undergone very lengthy and severe practical tests, and that they have been found to answer *most successfully*.

CHAPTER IV.

ELECTRO-MAGNETIC RAILWAY SIGNALS.

"What I can do, can do no hurt to try."
All's Well that Ends Well.

"I drink the air before me, and return,
Or e'er your pulse twice beat."
Tempest.

An attempt has been made within the last two years, to accomplish some of the ends proposed in the foregoing pages, by means of the ordinary electric telegraph instruments; but as they are not adapted to the work which they are intended to perform, it is not surprising to find that they have only partially succeeded, and for the same reason, the expense to those Companies who have made the experiment has been very great.

These instruments have usually two vertical needles, and the signals are represented by certain *preconcerted arbitrary* beats of these needles either to the right or to the left, it follows that as two instruments must be employed, one each for the down and up lines, that the movements of four needles have to be closely watched, in order to discover the meaning of the signals transmitted. This involves the necessity of employing a person well skilled in the manipulation of the electric telegraph; and the multiplicity of "beats" increases the liability to error, and opens the door to danger; but in addition to this, the indications made are not permament, so that no means of reference to the last signal given is afforded either to the sender or to the receiver, and consequently each has to trust to his *memory* as to the state of the line, and it will be readily understood that with the number of signals which have to be given in the course of each day on a railway where the traffic is considerable, that this is a very serious objection, and that mistakes may easily happen. Again, suppose a *wrong* signal has been sent, upon whom is the responsibility and blame to rest? A reference to the instruments will afford no information, as the

needles, after giving the signals, return to the vertical, and it will scarcely do to depend upon the statements of the officers, whose interest and inclinations would lead each to endeavour to exculpate himself. Further, under the arrangements at present existing, the instruments at *several* stations are connected with one wire, and are therefore in communication with each other; it follows that *each* instrument is acted upon whenever a current of electricity is sent along the wire, although the signal is intended for one of the stations only, and as it frequently happens that this wire is employed also for sending messages other than those applicable to the working of the trains, it may *and has* occurred, that at the *very moment* that a signal is required to be sent, the wire is pre-occupied. Captain Galton, R.E., who has paid considerable attention to this subject, says :—

"This system of working is not carried to the perfection which it admits of, *because the wires and instruments used for telegraphing trains are the same as those used for the transmission of messages;* and on this account the system is liable to occasional interruption, from the wire being occupied; *and besides, as the instruments are of a more complicated description than those which would suffice for merely telegraphing trains,* the duty requires to be performed by men *in some measure accustomed to the working of telegraphic instruments.*"

In addition to this very distinct opinion, we may add also the following, as expressed by the Directors of the Midland Railway, through their Secretary, as especially confirmatory of the above.

"With reference to the electric telegraph, the Directors quite concur in the opinion that a systematic working of all trains by telegraph would be desirable, if it could be accomplished; but they repeat their opinion, that the telegraph, *as at present arranged, does not admit of being worked with such certainty as to be depended upon for purposes of safety.*"

To this, Captain Simmons, R.E., by direction of the Board of Trade, replied :—

"My Lords desire me to state that they *entirely concur in that opinion.*"

It is very clear from the above, that whilst the Railway Commissioners of the Board of Trade, through their Inspectors

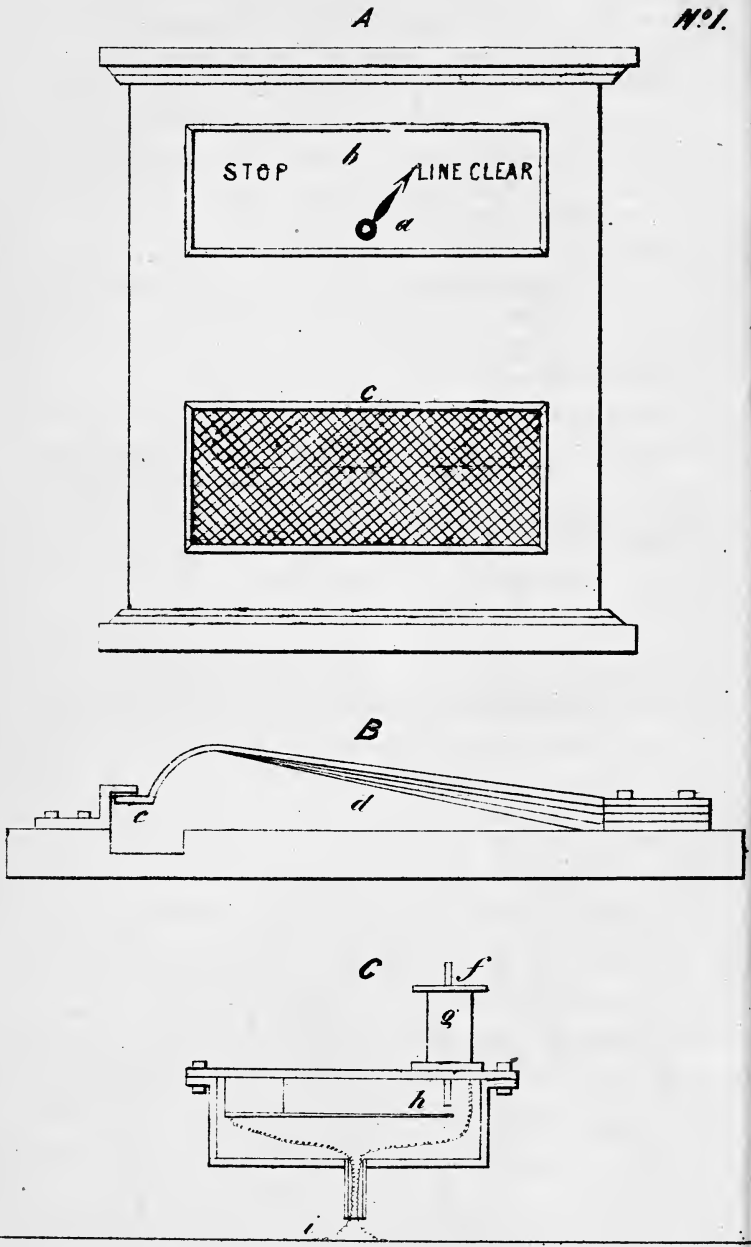
of Railways, have strongly and frequently urged the adoption of a system of signalling trains by means of the electric telegraph, yet that they consider the present arrangement of the instruments is not such an one as will *ensure* safety.

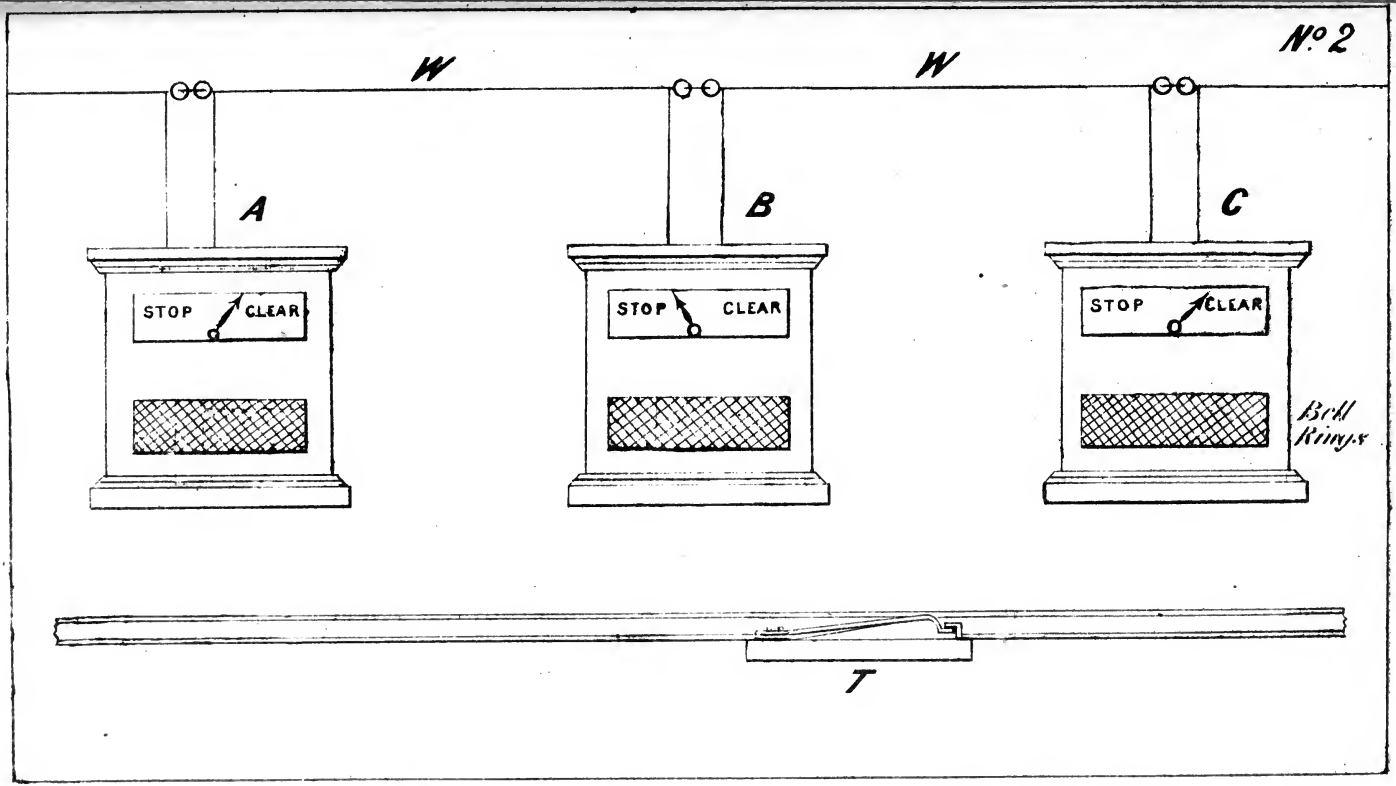
To effect the conditions which in the preceding chapter we stated to be absolutely essential in order to prevent collisions, instruments of quite a different construction are required, and these the ingenuity of Mr. Tyer, an Electrical Engineer, has supplied ; and as that gentleman has been permitted, through the courtesy of Captain Barlow, the General Manager of the South Eastern Railway, to test the greater portion of his invention during twelve months on a part of that line, and has also put the whole to most severe trials upon the lines of the "Saint Germain," and "Great Northern of France," in the presence of several scientific gentlemen, and railway and electrical engineers, and as these experiments have been in the highest degree satisfactory, we will venture to describe this *most important, yet simple* invention.

The principle adopted by Mr. Tyer is that which we have recommended, of preserving an interval of *space* and not of *time* between the starting of any trains, and this he accomplishes by instruments arranged to be either *self-acting*, or to work by *hand*, as may be preferred.

The description of the *self-acting* instrument is as follows :—

Let *A* (plate No. 1) represent an indicator fixed at every station, having a needle, or pointer, *(a)* which inclines to the words "Stop," or "Line Clear," engraved on the dial-plate *(b)*, according to the direction which the electric current is made to take through the instrument. At the bottom, but inside the instrument *(c)*, is placed a bell, which is rung by means of an electro-magnet. A little at the outside of each station, and by the side of the rail, is fixed a spring-treadle *B*, arranged in such a manner that the flange of every wheel of the train passes over and depresses it, the *treadle* being raised by the spring *(d)* underneath, immediately the wheel has passed. Under the part *(e)* is fixed a "connector" *C*, having a small piston *(f)* passing through a compound spring enclosed in a cylinder *(g)*. Upon the passage of a wheel


A
No. 1.
STOP
b
LINE CLEAR
a
c
B
c
d
C
f
g
h
i


No 2
W
W
A
B
C
STOP
CLEAR
STOP
CLEAR
STOP
CLEAR
Bell Rings
T

over the treadle *B* the part *(e)*, being depressed, comes into contact with the piston *(f)*, which, in its turn, presses against a metal spring *(h)*, to which the line wire *(i)*, leading to the stations and indicators, is attached. The electric circuit being completed each time a wheel passes over the treadle, a current of electricity passes along the line-wire, with the following results:—The bell at the station in advance is rung several times, announcing to the officials there that a train has left the preceding station, and giving them therefore timely notice to prepare for its reception. The indicator at the station just left, would go over to "Stop," because a train is on the line between it and the next station, and the indicator at the previous station would at the same moment show "Line Clear."

But in order to understand this more clearly, let *A B C*, (plate No. 2) represent the indicators at three stations. *W* is the line wire in communication with each of these indicators, *T* is the treadle at station *B*. Let us suppose the train to have just passed *A*, the bell at *B* would be ringing, and so announcing the approach of a train, whilst the indicator at *A* would be at "Stop," and that of *B* at "Line Clear." The train therefore proceeds, and on its departure from *B* the bell at *C* commences ringing, the indicator at *B* passes over to "Stop," and that at *A* to "Line Clear." (Vide plate No. 2.) The station-master at *B* therefore, will *stop* every succeeding train at his station, until his indicator is reversed to "Line Clear," which will be the case so soon as the train passes over the treadle at *C*, the indicator at which station would then be at "Stop," and so on the entire length of the line.

In this manner, *the train itself* gives notice of its progress, both in the rear and in the advance; but as many railway managers would prefer having the means of attaching a responsibility to individuals for the correct performance of their duties, to any *self-acting* system whatever, Mr. Tyer has invented a *hand-instrument*, of which the plate No. 3 is a representation; with this instrument the "treadle" is not employed. The upper part *(k)*, or receiving portion, is the same as before described, (fig. *A*, plate No. 1,) the lower part *(l)* is the trans-

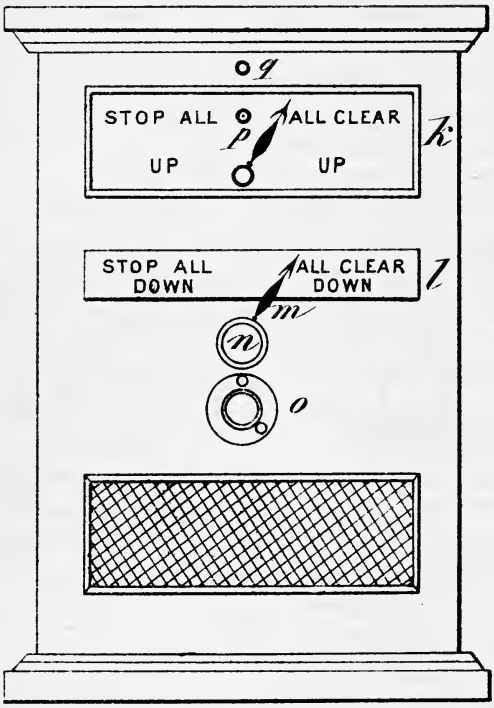
mitting portion, the needle *(m)* is made to incline to the right or to the left, at the will of the operator, by turning the brass button *(n)*, to which it is attached, and which has the effect of reversing the direction of the current; *(o)* is a stud which upon being pressed rings the bell at the station in advance.

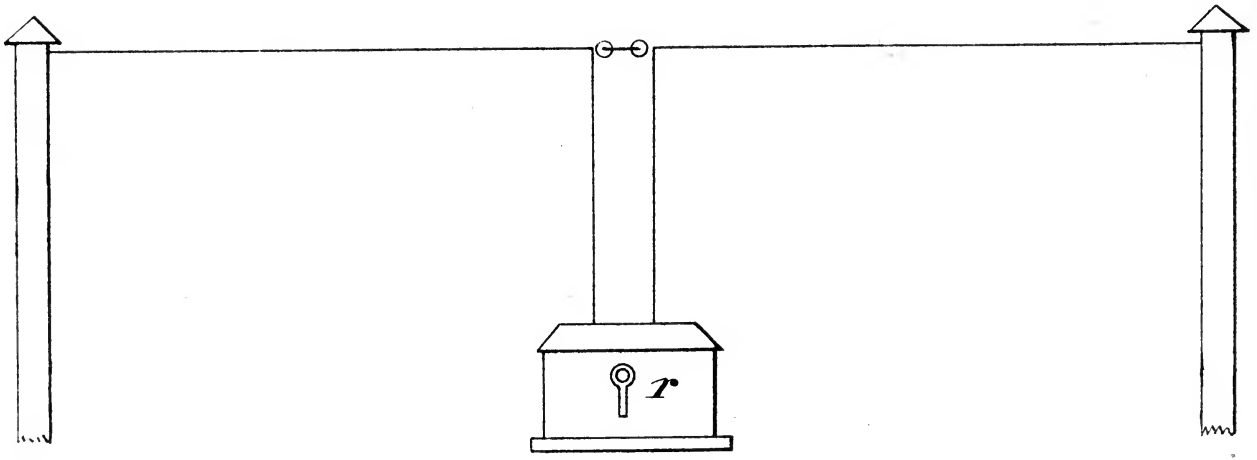
The *modus operandi* will be as follows. Upon the train's approach to station *B*, the clerk will, by pressing the bell stud, ring the bell at *C*. This is to be considered as an enquiry as to the state of the line. *C* will reply by ringing the bell at *B*, intimating that he is aware of the latter having called him. If it is safe for the train to proceed on its way, *C* will put the needle of the *transmitting* portion of the instrument *(l)* over to "Line Clear," and the indicator at *B* will then register the same signal, and the train will be permitted to pass *B*, the clerk at that station then giving the signal "Line Clear" to *A*.

When *shunting* is about to take place, or any other obstruction prevents the coming on of the train, the clerk at *C* will put the needle of his transmitting instrument at "Stop," and *B* will be apprised of the same by the ringing of his bell, and also by his own instrument following the movement.

It must be remembered that the signal given *remains fixed* until a new signal be sent; so that a station-master wishing to inform himself what was the last signal either *received or sent* by him can readily do so, and he has only to look to his indicator to ascertain at any time the state of his portion of the line.

One great advantage in this description of instrument is that the station *receiving* the signal *cannot alter it*, this can only be done by the sender, consequently if an improper signal be given, or there is any inattention to the signal given, the offender is at once discovered; further, *if required*, it can be so arranged, and that by an exceedingly simple contrivance, that no station-master shall be able to alter the indicator of another, without the consent of the receiving station, whilst the latter cannot alter it, unless by the aid of the sender at the next station, thus—a small hole (*p*) is drilled in the dial plate, through which an ivory stop projects in such a manner as to prevent the needle passing over; *q* is a small stud which when pressed withdraws the ivory stop (*p*); upon the bell ringing, the station master or


q
STOP ALL
ALL CLEAR
p
UP
UP
k
STOP ALL
DOWN
ALL CLEAR
DOWN
l
m
n
o


r

officer in charge of the indicator, after replying by pressing the bell stud (*o*), and ringing the bell at the transmitting station, removes the ivory stop (*p*), by pressing against the stud (*q*), when the needle will immediately pass over to the signal sent.

This hand system, with the last described arrangement, is that preferred by Captain Barlow, after very lengthy and severe experiments of all.

Another and a very important recommendation, is, that by the latter method *one* line wire only is required for both the up and down lines, instead of *two*, as by the ordinary telegraphic instruments, thus a great saving of expense is effected.

Notwithstanding these precautions, it may happen, that a train after having passed a station (say *B*), may become derailed, have an axle broken, or by some other accident be detained; in such a case its rear would be protected from any following train, because the indicator at *B* would be at "Stop," in consequence of the non-arrival of the train at *C*. But it is highly important that the guards should remain with the train, so as to render every assistance in their power, instead of being despatched each way, as under the present imperfect system, to stop coming trains. It is equally essential that the station on either side should be apprised of the accident, so that speedy assistance may be forwarded to the scene of the catastrophe.

A very simple plan will effect this. On the telegraph posts at every quarter mile, a wire in connection with the line wire is brought down to a small deal box *(r)*, (plate No. 4), which is kept locked, every guard and driver having a key to open the same. In the event of such an accident occurring, the *greatest* distance to be traversed by the guard to one of these boxes, will be one-eighth of a mile; upon his arrival at, and opening the box, he would be enabled, by pressing against a small stud, to ring a bell violently at the station on either side of him, and continue the alarm so long as he may deem necessary.

Having thus provided for the actual safety of the train, and of several of the conditions before mentioned, *if an efficient communication be made with the engine-driver and guards*, the question now arises, *how* such communication is to be made, so as

to ensure not only the receipt of the signal by them, but also their noticing the same when sent, and that in all conditions of the weather and atmosphere, as well by night as by day.

This, like the arrangements previously described, is of the simplest character. Along the line two parallel bars of wood, having surfaces of iron or other metallic substances, (fig *D*, plate No. 5,) are fitted at certain intervals; at each station is fixed an instrument called a "Lock commutator" (*E*) having the words "Danger" and "Line Clear" engraved thereon. Whenever it is necessary to send a signal *to a train*, the station master will with a key (*s*) similar to an ordinary lock key, turn a bolt or slide in this "lock commutator," either to the right or to the left, the needle (*t*), following the direction to "Danger" or "Line Clear," as the case may be. The effect of this is, to transmit either a *positive* or *negative* current of electricity along the line to the bars (*D*) before described, which become charged with the current; the engine and guard's van are each fitted with a pair of metallic springs (*F*), adjusted in such a manner as to come into contact with, and glide over the bars, the current immediately flows up one of these springs to a small magnetic needle instrument (*G*) fitted on the dome of the engine, and before the eyes of the driver, and similarly, on the passage of the guard's van over the bars, to the instrument fitted therein; these instruments at once record the signal sent *from* the station *(the needle remaining fixed)*, whilst *at* the station the upper portion of the instrument (*E*) being in connection with the wire leading to the bars, is instantaneously operated upon, and registers the same signal as that received by the driver and guard, putting it entirely out of the power of either to say that the signal had not been transmitted, for inasmuch as that the electricity *must* pass through the engine instrument *before* reaching that at the station, *it is not possible* for the latter to be operated upon without the former having first received the like signal. If the signal given is "All right," the driver proceeds on his journey; if, on the contrary, the "Stop" signal be given from the station, at the first parallel bars reached by the engine, the driver and guard will each be informed thereof, when the former will shut off his steam, and the latter apply his breaks,

and this without any intercommunication from guard to driver, or from driver to guard. In order however to provide against the possibility of danger arising through the driver being asleep, or otherwise the signal escaping his notice, an arrangement is made by which the steam-pipe from the boiler to the whistle is opened (on every occasion of a signal being received) and the latter keeps sounding until the *driver* himself shuts it off; but this is not all: by a remarkably simple mechanical contrivance, the same busy current of electricity will operate upon the *regulator* of the steam to the machinery, and however incredible it may appear, will absolutely *shut off* the steam, and the train will come to a stand-still. The importance of this will be readily reognized in the event of a "run-away" engine.

We would wish to observe, that we have not been indulging in any *fanciful or theoretical speculations*, but have simply detailed that which *has been done* by Mr. Tyer over and over again, *without a single failure;* that each division of his invention is *distinct from the other, and can be applied separately*, and that the expense of introducing the same is remarkably small, whilst its future maintenance is trifling as compared with the present imperfect and complicated arrangements of semaphores, distant and auxiliary signals, (none of which would be required,) and the painting, burning of oil, &c., to say nothing whatever of the increased security and protection which it affords, and the consequent saving of enormous outlays at present incurred by Railway Companies, in the replacing and repairs to engines, carriages, permanent way, &c., and the monetary recompense to be made to injured persons and orphan families, whenever a "collision" unfortunately occurs.

The whole of the apparatus now described, is dependent upon no complicated machinery requiring a constant supervision to prevent its derangement, and to preserve it in good working order; on the contrary, its extremely simple contrivances are its greatest recommendation. It embraces the three requirements which Lieut. Tyler considers absolutely necessary for railway signals, *viz.*, "*Simplicity, Readiness, and Certainty;*" and as the whole of the invention is based upon a simple law of nature, these requirements must always be fulfilled.

In conclusion, and in order to confirm the opinion expressed in the efficacy of the plan submitted in the preceding pages, and of the invention just described, for carrying the same into effect, we cannot do better than to quote the written opinions of those, who from their practical knowledge of the subject are well qualified to offer them.

M. l'abbe Moigno, the celebrated Parisian writer on electricity, after having witnessed the trials on the "Saint Germain" and the "Great Northern of France" Railways, before referred to, wrote in "Cosmos," 15th September, 1854, (page 332.)

* * * * * * * *

"Le système de M. Tyer est évidemment bon et efficace en théorie ou en lui-même; il tient un juste milieu entre un contrôle purement mécanique et un contrôle qu'on pourrait appeler purement moral, c'est-à-dire qui dépende uniquement de l'exercice des volontés humaines, de la vigilance des gardiens. Il demande à l'électricité juste ce qu'il faut lui demander, et laisse à l'homme la responsabilité dont on ne peut pas, dont on ne doit pas le décharger.

"Ce qu'il fallait pour faire accepter les dispositions nouvelles, c'était de prouver qu'elles restaient dans la pratique ce qu'elles sont en théorie; qu'il ne se présentait aucune difficulté insurmontable, que chaque mécanisme, très-simple d'ailleurs, produisait son effet à coup sûr, que le but proposé était toujours atteint, au moins dans l'immense majorité des cas; et c'est, comme nous l'avons dit au commencement de cet article, ce qui est résulté d'une longue expérimentation, ou mieux d'un service régulier de huit mois, en Angleterre, sur le South-Eastern, près de la station du pont de Londres, c'est-à-dire au point où les trains se succèdent avec le plus de rapidité.

"Parfaitement bien organisés grâce, à la bienveillance de l'administration et à la complaisance des ingénieurs, les essais auxquels nous avons assisté dans la gare du chemin de fer du Nord n'ont rien laissé à désirer; la réussite de M. Tyer a été complète; nous pourrions citer les noms de quelques inspecteurs soit des chemins de fer, soit des télégraphes, qui, après avoir conçu quelques doutes et soulevé quelques objections, nous ont avoué franchement, qu'en y réfléchissant bien, ils étaient arrivés à se convaincre eux-mêmes de l'excellence et de l'efficacité du nouveau système.

"Il ne nous reste donc plus qu'un vœu à former, c'est que les directeurs des compagnies, hommes de conscience et de savoir, fassent taire les scrupules matériels et misérables d'une dépense à ajouter à leur budget."

"F. Moigno."

The following is the copy of a letter written by Captain Barlow, after that gentleman had tried the invention for *eight* months:—

"South-Eastern Railway,
"London Terminus, 24*th January*, 1854.

"Dear Sir,

"In reply to your request that I should express an opinion upon the principle and practice of the self-acting Electro-Magnetic Signals, placed by you at the New Cross, Lewisham, and Blackheath Stations, for the purpose of notifying the arrival and departure of trains to the Stations respectively in rear and advance, I have much pleasure in stating that, during the eight months they have been in action, their performance has been regular, and that they have not been subject to any derangement of an unusual character.

"With regard to the principle, I am of opinion, that by doing away with the treadle, and so arranging that the signal man at each station should have the power of giving the signal *by hand*, you will have effected the *most valuable method of signalling trains which has been brought forward*, and one which will give the officers in charge of Stations a confidence in the working of the Railway *hitherto not attained by needle instruments*.

"I am, Dear Sir, yours truly,

(Signed) "R. H. BARLOW."

"To Mr. Edward Tyer."

The *hand* system of signalling here recommended is now in successful operation at these stations of the South-Eastern Railway, a prelude (it is hoped) to its use throughout the whole of the same.

Captain Galton, in his report, page 201, says :—

"The true system of working a line by electric telegraph, is to devote one wire exclusively to this purpose, and to place it in connexion with simple instruments capable of striking a bell, and giving two signals,—such, for instance, as "*Line Clear*," and "*Stop*." These instruments should be placed at such distances apart, as would meet the requirements of the traffic, that is to say, on lines of very large traffic, and numerous trains, it might be necessary to have them at as small intervals as a mile; whilst on lines where the traffic is limited, and conducted in a small number of trains, it might be sufficient to place them at the ordinary passenger stations. But whatever the length of each portion of line between the instruments, no train should be allowed to enter upon one portion, until the preceding train had left that portion. * * * *

"This method of working a railway appears to me to be *the only method* which can effectually secure in practice safety from collision between trains proceeding in the same direction, especially upon lines where the trains are

numerous, and where they travel at different rates of speed, and accidents from this cause have hitherto been more numerous than from any other cause.

"In my opinion, this system of conducting the traffic cannot be too strongly or too frequently impressed upon Railway Companies, as being one which is especially desirable upon lines of large traffic, traversed by trains at different rates of speed; and I would remark that great credit appears to me to be due to the South-Eastern Railway Company, for having been the first Company who have discovered its advantages, and practically applied them. I would, however, suggest that it is extremely desirable that the *above-mentioned more perfect system of telegraphing trains should be extended as rapidly as possible* over the whole of the South-Eastern Railway and branches; *and the sense of security which will be derived from it will far more than repay the cost of establishing it.*"

Let us hope that after such a very distinct expression of opinion, that Railway Companies will no longer hesitate in adopting a plan so capable of preventing a recurrence of such frightful calamities as railway collisions have hitherto produced.

APPENDIX.

RAILWAY COLLISIONS.

The following Circular has been issued by the Railway Department of the Board of Trade :—

"Whitehall, August 12, 1854.

"Sir,—The Lords of the Committee of Privy Council for Trade are desirous of calling the attention of railway companies to a system of working the trains, which is in use on some railways to a limited extent, and which promises to afford security from accidents, occasioned by collision between trains following each other upon the same line of rails.

"This class of accidents has been hitherto very numerous, as compared with other classes. In 1853 the total number of accidents to trains reported to this department was 103, of which 30 occurred to trains following each other upon the same line of rails; and, in the six months ended the 30th of June in the present year, the total number of accidents to trains which came under the cognizance of this department amounted to 47, of which 13 occurred by collision between trains following each other upon the same line of rails.

"The system under which trains are ordinarily worked is, that trains should not be allowed to approach each other within a certain interval of space; and, to effect this object, signals are exhibited during a certain time after the passage of a train, and no succeeding train is allowed to follow until such interval has elapsed.

"Experience, however, shows that this mode of endeavouring to secure a certain interval of space between succeeding trains will occasionally fail, in cases where the speed of the respective trains varies, or where accidents occur to the machinery of trains; and when, from any cause, a train becomes stationary on a part of the line away from stations, its safety from a collision with a succeeding train is dependent upon the chance of such succeeding train being at such a distance as to allow time for the guard to run back with a signal.

"With the view of effectually securing that an interval of space shall, under all circumstances, be at all times maintained between trains following each other upon a line of railway, the South-Eastern Railway Company have, on a portion of their railway, placed electric telegraphic stations at intervals along the line; and no train is allowed to pass one of these stations, and to move upon the line between it and the next station, until a notification has been received from the next station that the preceding train has passed off that portion of line.

"On portions of the line where the trains are numerous, and the intervals between them are necessarily very short, these stations have been placed at little more than a mile apart; but, upon parts of the line where the number of trains is more limited, the distance between the ordinary passenger stations has not been found too great an interval.

"Into the detailed arrangements my Lords purposely abstain from entering; they would, however, add, that in order that the system should be effectual, it is necessary that a telegraphic wire be exclusively reserved for this service; and that the instruments used should be simple, and should exhibit the signals with sufficient clearness for the signalling to be carried on by a person of ordinary intelligence.

"My Lords are aware that, from considerations of expense or otherwise, this system has not been generally adopted; yet, in parts where a single line only has been laid, or where peculiar difficulties exist in the working, or in tunnels, directors of railway companies have resorted to it with the most beneficial results.

"My Lords are, therefore, desirous that the subject should receive the careful consideration of the directors of the different companies, in the hope that that consideration may lead to the more general adoption of a plan which experience seems to have proved to be so well calculated to diminish the risk of danger.

"I have the honour to be, Sir,
"Your most obedient servant,
"DOUGLAS GALTON,
"*Captain Royal Engineers.*"

Leading Article from "the Times," August 16, 1854.

In another column will be found an official communication on a subject which, at a period like the present, when all the world is upon the rail, must needs command very general attention. It has appeared to the Railway Department of the Board of Trade, that means have been at length discovered of obtaining something like actual security from at least one description of railway accidents; and they have accordingly issued a circular manifesto, inviting the careful consideration of those authorities with whom it rests to bring the precautions referred to into general operation. The scheme professes to secure nothing less than the prevention of all such accidents as arise from the collision of trains following each other upon the same line, a result which would be almost tantamount to the prevention of all collisions whatever. "This class of accidents," observes the circular, "has been hitherto very numerous as compared with other classes," a circumstance which there can be no difficulty in understanding. In point of fact, it might be almost laid down as a formula in such matters, that it takes two trains to make an accident. If there where such things in England as lines traversed by one train only in the day, we should hear of very few casualties under such

arrangements. Now and then, it is true, an engine gets off the line, or a carriage breaks down, or an accident is in some other way manufactured without the aid of any extraneous ingredient, but in the great majority of cases it is a second train which does all the mischief. The first accident, whether occurring from breakage, or overloading, or insufficient locomotive power, or bad weather, or defect in the permanent way, would amount in many, perhaps in most instances, to little worse than the shock of a sudden stoppage, when up comes train No. 2, runs headlong into the disabled No. 1, and converts the stoppage into hideous and mortal disaster. If, therefore, it could be rendered a matter of certainty that no train, whether disabled or delayed, could ever be overtaken by a second one, a productive source of railway accident would undoubtedly be removed, and this is what it is now hoped to accomplish.

The method of proceeding, as usually happens in all such cases, is extremely simple. The result to be secured is, that no train shall enter upon any given portion of a line until it is ascertained that such portion of a line is free from obstruction. Lines are already divided into portions by the successive passenger stations; and if, therefore, it could be always communicated from one station to another immediately above or below it that the last on its passage had gone safely by, the object in view would be so far obtained. But the means of such communication are already provided to perfection by the electric telegraph, and here, therefore, is the problem solved. Such, indeed, and no more, is the solution now before us. The Railway Department of the Board of Trade, having heard that a certain company—the South-Eastern—has actually brought such a system into operation, recommends the adoption of the practice by other companies. That is the sum total of the design. Railway directors are simply advised to consider whether, inasmuch as they possess means of instantaneous communication between any one point of their lines and any other point, and such communication, fairly carried out, would prevent a numerous class of accidents, it would not be advisable to turn the opportunity to account, and diminish the risks of travelling accordingly.

The first thing that strikes us in this circular is the circumstance of its being called for at all, or issued only in the year 1854. The most obvious use of the electric telegraph, when first discovered, was in aid of these railway exigencies, and yet, as is well known, railway companies for some time repudiated this valuable instrument altogether. Both on the London and Birmingham line and on the Great Western line the invention, after being actually brought into use, was deliberately discarded. Now, however, as it is everywhere in practical operation, why should it not long since have been turned to this the most natural as well as the most beneficial of all purposes in preventing disaster, by the instantaneous distribution of information? The circular supplies us with an answer—"My Lords" represent themselves as "aware that, *from considerations of expense*, or otherwise, this system has not been generally adopted." But what is the expense, either in itself

or as compared with the results obtainable? It seems that where trains are very numerous, and the intervals between them unavoidably short, it may become necessary to have special electric stations at intervals of little more than a mile apart, and the establishment of such a chain would, of course, be attended with some outlay. Yet even here the very origin of the necessity points to a compensating return, for, if the trains are so numerous as to require all this precaution, the receipts must be in proportion, and extraordinary traffic would be set against extraordinary expense. On parts of the line where the traffic is less continuous the ordinary passenger station would, it is said, be close enough to each other for all the necessary purposes. All that is required is, that there should be one telegraphic wire reserved for these communications exclusively, and that all the arrangements of the service should be simple.

Supposing this scheme were brought into general operation, and every line divided by electric stations at longer or shorter intervals, no train would be allowed to pass station A on its road to station B until it had been distinctly notified by a communication from B to A that the train last started had passed off that portion of the line, and left the space between A and B undoubtedly clear. At present this kind of security is only very imperfectly obtained. The common practice is to intimate by means of signals that the road is or is not free for the passage of a train on the track of that immediately before it. If the first train has passed the spot in question a certain number of minutes before the second train comes up, the signalman notifies that all is right, and train No. 2 proceeds on its journey. If No. 1 has been delayed by any accident, then No. 2 is delayed also. This system, however, is only good as far as it goes, and no further. What is wanted is the certification that train No. 1 has passed clear away from the whole space between the point where the signal safety is exhibited and the next point where a like signal will be forthcoming; and no such assurance can, under the present system, be obtained. All that can be certified is, that the first of two trains has passed by that particular spot at its appointed hour, and that it *ought*, consequently, to be out of reach of the second. But, if any accident should happen to the machinery, or the speed of the engine should be materially slackened, this consequence will not have followed, and the train may be lying disabled within, perhaps, a mile of the spot which it passed at its accustomed speed a quarter of an hour previously. Under the new system this contingency would be escaped, for the safety signal, when exhibited, would imply not merely that the train had passed *that* spot, but that it had passed another spot at some distance where the like assurance would be repeated. That these regulations may give some trouble is possible enough, and, perhaps if they had never been put in practice, we should be assured by railway authorities that they were utterly impracticable. Fortunately, however, the experiment has been made, and we trust soon to see the general adoption of a scheme promising such material advantages to companies and travellers together.